



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/555,710	08/11/2006	Kazushige Yonenaga	5259-000060/US/NP	9721
27572 7590 06/19/2009 HARNESS, DICKEY & PIERCE, P.L.C. P.O. BOX 828 BLOOMFIELD HILLS, MI 48303			EXAMINER LIU, LI	
			ART UNIT 2613	PAPER NUMBER
			MAIL DATE 06/19/2009	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of Species 12 in the reply filed on 4/30/2009 is acknowledged.
2. The applicant elects Species 12 and claims 1, 20-25, 42 and 43. But, the claim 24 belongs to Figure 6 (drawn to Species 4). During the telephone conversation with applicant's representative Timothy MacIntyre on 6/17/2009, the Examiner explained the case, and Timothy MacIntyre agrees to withdraw claim 24.
3. Claims 2-19, 24 and 26-41 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected Species 1-11, there being no allowable generic or linking claim.

Information Disclosure Statement

4. The information disclosure statement (IDS) submitted on 11/4/2005 and 7/15/2008 is being considered by the examiner.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.
6. Claim 20 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 20 recites the limitation "the infinitesimal-modulated signal oscillation circuit" in lines 3-4. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 1, 21, 25 and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tomioka et al (JP2003-309520, English machine-translation of JP2003-309520) in view of Kim et al (US 6,271,959).

1). With regard to claim 1, Tomioka et al discloses an optical transmission system (e.g., Figures 1, 8 and 9 etc) comprising:

an optical transmitter (e.g., optical transmitter 7 in Figure 1) which outputs differential-encoded phase-modulated light (Figure 2(b) and (c) show the differential-encoded phase-modulated light); and

an optical receiver (e.g., the optical receiver 8 in Figure 1) which detects the phase-modulated light and performs demodulation (11 in Figure 1 is the demodulated output, also refer Figure 10);

wherein the optical transmitter comprises:

an encoder (the NRZ-I encoder 3 in Figures 1 and 3) which converts NRZ code input signals into NRZ-I code signals; and a phase modulator (the phase modulator 2 in

Art Unit: 2613

Figure 1) which, for marks and spaces encoded by the encoder (Figure 2), outputs phase-modulated light with a phase deviation $\Delta\phi$ imparted over a range $0 \leq \Delta\phi \leq \pi$ (Figure 2, [0036], phase change is 0 or π).

the optical receiver comprises:

a Mach-Zehnder interferometer (the Mach-Zehnder interferometer 9 in Figures 1 and 9) with phase-adjustment terminal to set a phase difference between two interfering signals (Figure 7, [0036] and [0042]), which splits the phase-modulated light which has been received into two signal light beams (Figure 9, two beams 19 and 20 are outputted), delays one of the split signal light beams by one bit ([0036], $D=1$ -bit time), and causes the two signal light beams to interfere to effect conversion into intensity-modulated light (Figure 10);

a balanced detection circuit (32 in Figure 9) which performs photoelectric conversion of signal light from two output ports of the Mach-Zehnder interferometer, and outputs a difference in converted electrical signals (the output from the balanced receiver 32 in Figure 9);

a low-frequency signal generation circuit (Figure 7, the oscillator 23) which applies a first low-frequency signal at frequency f_1 to the phase-adjustment terminal of the Mach-Zehnder interferometer ([0042]);

an infinitesimal-modulated signal component detection circuit (e.g., the electric eye 25 in Figure 7) which detects a second low-frequency signal (Figure 7, the signal tapped from the interferometer);

Art Unit: 2613

a synchronous detection circuit (e.g., the synchronous detector 24 in Figure 7) which, by synchronous detection of the second low-frequency signal (signal output from the detector 25 in Figure 7) output from the infinitesimal-modulated signal component detection circuit using the first low-frequency signal (the signal from the oscillator 23 in Figure 7) output from the low-frequency signal generation circuit, detects a shift amount and direction of shift between a center wavelength of the phase-modulated light output from the optical transmitter and a pass band wavelength of the Mach-Zehnder interferometer ([0041]-[0042], Figure 6 shows the pass band of the MZ interferometer, the feedback control and the synchronous detector detects the shift or whether “center wavelength of a Mach-Zehnder interferometer has carried out outline coincidence with wavelength of a light source”);

a control circuit (e.g., the mixer 27 in Figure 7) which outputs a control signal to adjust the phase difference between the two split signal light beams so as to correct the shift amount ([0042], the output from the 27 controls the MZ interferometer); and

a driver circuit (Figure 7, the mixer also acts as the driver) which drives the phase adjustment terminal based on the control signal (Figure 7).

But, in Figure 7, Tomioka et al uses a separated photodiode (25 in Figure 7) to detect a second low-frequency signal. Tomioka et al does not expressly disclose that the infinitesimal-modulated signal component detection circuit detects the second low-frequency signal from a signal supplied by the balanced detection circuit.

However, Kim et al, in the same field of endeavor, teaches a system and method to stabilize the Mach-Zehnder interferometer, in which a detection circuit (23 in Figure

Art Unit: 2613

5A) detects a signal from a signal supplied by the balanced detection circuit (18 in Figure 5A, column 8 line 42-65).

By using the signal directly from the balanced detection circuit, the system becomes simplified and no extra detector is needed. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the teaching of detecting the signal from the balanced detection circuit as taught by Kim et al to the system of Tomioka et al so that the system is less complicated and cost can be reduced.

2). With regard to claim 25, Tomioka et al an optical receiver (e.g., 8 in Figures 1 and 7), in an optical transmission system comprising:

an optical transmitter (e.g., optical transmitter 7 in Figure 1) which outputs differential-encoded, phase-modulated light (Figure 2(b) and (c) show the differential-encoded phase-modulated light); and

the optical receiver which detects the phase-modulated light and performs demodulation (11 in Figure 1 is the demodulated output, also refer Figure 10),

wherein the optical transmitter comprises: an encoder (the NRZ-I encoder 3 in Figures 1 and 3) which converts NRZ code input signals into NRZ-I code signals; and a phase modulator (the phase modulator 2 in Figure 1) which, for marks and spaces encoded by the encoder (Figure 2), outputs phase-modulated light with a phase deviation $\Delta\phi$ imparted over the range $0 \leq \Delta\phi \leq \pi$ (Figure 2, [0036], phase change is 0 or π),

the optical receiver comprises:

a Mach-Zehnder interferometer (the Mach-Zehnder interferometer 9 in Figures 1 and 9) with phase-adjustment terminal to set a phase difference between two interfering signals (Figure 7, [0036] and [0042]), which splits the phase-modulated light which has been received into two signal light beams (Figure 9, two beams 19 and 20 are outputted), delays one of the split signal light beams by one bit ([0036], $D = 1\text{-bit time}$), and causes the two signal light beams to interfere to effect conversion into intensity-modulated light (Figure 10);

a balanced detection circuit (32 in Figure 9) which performs photoelectric conversion of signal light from two output ports of the Mach-Zehnder interferometer, and outputs a difference in converted electrical signals (the output from the balanced receiver 32 in Figure 9);

a low-frequency signal generation circuit (Figure 7, the oscillator 23) which applies a first low-frequency signal at frequency f_1 to the phase-adjustment terminal of the Mach-Zehnder interferometer ([0042]);

an infinitesimal-modulated signal component detection circuit (e.g., the electric eye 25 in Figure 7) which detects a second low-frequency signal (Figure 7, the signal tapped from the interferometer);

a synchronous detection circuit (e.g., the synchronous detector 24 in Figure 7) which detects a shift amount and direction of shift between a center wavelength of the phase-modulated light output from the optical transmitter and a pass band wavelength of the Mach-Zehnder interferometer (Figure 6 shows the pass band of the MZ interferometer; [0041]-[0042], the feedback control and the synchronous detector

Art Unit: 2613

detects the shift or whether “center wavelength of a Mach-Zehnder interferometer has carried out outline coincidence with wavelength of a light source”), through synchronous detection of the second low-frequency signal (signal output from the detector 25 in Figure 7) output from the infinitesimal-modulated signal component detection circuit using the first low-frequency signal (the signal from the oscillator 23 in Figure 7) output from the low-frequency signal generation circuit;

a control circuit (e.g., the mixer 27 in Figure 7) which outputs a control signal to adjust the phase difference between the two split signal light beams so as to correct the shift amount ([0042], the output from the 27 controls the MZ interferometer); and

a driver circuit (Figure 7, the mixer also acts as the driver) which drives the phase adjustment terminal based on the control signal (Figure 7).

But, in Figure 7, Tomioka et al uses a separated photodiode (25 in Figure 7) to detect a second low-frequency signal. Tomioka et al does not expressly disclose that the infinitesimal-modulated signal component detection circuit detects a second low-frequency signal from a signal supplied by the balanced detection circuit.

However, Kim et al, in the same field of endeavor, teaches a system and method to stabilize the Mach-Zehnder interferometer, in which a detection circuit (23 in Figure 5A) detects a signal from a signal supplied by the balanced detection circuit (18 in Figure 5A, column 8 line 42-65).

By using the signal directly from the balanced detection circuit, the system becomes simplified and no extra detector is needed. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the

Art Unit: 2613

teaching of detecting the signal from the balanced detection circuit as taught by Kim et al to the system of Tomioka et al so that the system is less complicated and cost can be reduced.

3). With regard to claims 21 and 43, Tomioka et al and Kim et al disclose all of the subject matter as applied to claims 1 and 25 above. And the combination of Tomioka et al and Kim et al further discloses

wherein the optical receiver comprises:

an optical carrier frequency detection unit (e.g., Tomioka: the electric eye 25 and the synchronous detector 24 in Figure 7) which detects, from received signal light detected by the balanced detection circuit, a relative position between an optical carrier frequency and an optical frequency characteristic of the Mach-Zehnder interferometer ([0041]-[0042], Figures 6 and 7, the feedback control and the synchronous detector detects the shift or whether “center wavelength of a Mach-Zehnder interferometer has carried out outline coincidence with wavelength of a light source”, that is, the detection circuit is the optical carrier frequency detection unit, which detect a relative position between an optical carrier frequency and an optical frequency characteristic of the Mach-Zehnder interferometer); and an offset setting circuit ([0042], synchronous detector 24 and filter 26 also serves as the offset setting circuit, which outputs offset signal to the control circuit 27) which provides an offset to a feedback error signal in the control circuit ([0042], the feedback control loop shows in Figure 7 controls the center wavelength of the light interferometer within the optical receiver 8, the synchronous detector 24 compares the signal from the detector 25 and the signal from the oscillator

Art Unit: 2613

23, and then an offset is obtained, and the “offset” is sent to the Mixer 27, and then, a feedback error signal is formed in the control circuit 27),

a value of the offset of the offset setting circuit is adjusted such that the position of the optical carrier frequency matches a peak position or bottom position of the optical frequency characteristic of the Mach-Zehnder interferometer (Figures 6 and 9; [0035], “An inhibition center wavelength or a transmission center wavelength of Mach-Zehnder interferometer 9 is set up or controlled to carry out outline coincidence with a center wavelength of the light source 1”; that is, the position of the optical carrier frequency matches a peak position or bottom position of the optical frequency characteristic of the Mach-Zehnder interferometer).

9. Claims 20 and 42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tomioka et al and Kim et al as applied to claim 1 and 25 above, and in further view of Kobayashi et al (JP2004-037647, English machine-translation of JP2004-037647) and Nishimoto et al (US 5,359,449).

Tomioka et al and Kim et al disclose all of the subject matter as applied to claim 1 above. But, Tomioka et al and Kim et al do not expressly disclose wherein the Mach-Zehnder interferometer is provided with two independent phase adjustment terminals, and an output of the infinitesimal-modulated signal oscillation circuit is applied to one of the two phase adjustment terminals, while a feedback error signal within the control circuit is applied to the other of the two phase adjustment terminals.

However, Kobayashi et al discloses a system and method to stabilize a Mach-Zehnder interferometer, in which the Mach-Zehnder interferometer is provided with two

Art Unit: 2613

independent phase adjustment terminals (e.g., Figures 1 and 7, two terminal: signal electrode accepting signal from circuit 13 and bias electrode receiving signal from bias control circuit 14), and an output of the infinitesimal-modulated signal oscillation circuit (the low frequency oscillator 12 in Figure 1 and 7) is applied to one of the two phase adjustment terminals (e.g., Figure 1, bottom of the MZ modulator 3), while a feedback error signal within the control circuit (14 in Figures 1 and 7) is applied to the other of the two phase adjustment terminals (e.g., Figure 1, top of the MZ modulator 3).

But, in Figures 1 and 7, Kobayashi et al does not expressly show the two electrodes. However, Nishimoto et al, in the same field of endeavor, discloses a feedback control circuit to control the Mach-Zehnder interferometer (e.g., Figures 1 and 11), and the signal electrode 12 and bias electrode 16 are shown in the Mach-Zehnder interferometer in Figures 1 and 11. And the signal electrode 12 is applied a low frequency signal from the oscillator 34, and the bias electrode 16 is applied the feedback control signal from the driver 66/synchronous detecting circuit 60.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the control mechanism as taught by Kobayashi et al and Nishimoto et al to the system of Tomioka et al and Kim et al so to provide Mach-Zehnder interferometer with two independent phase adjustment terminals in the receiver side, and then the interferometer can be more accurately and conveniently controlled and the system become more reliable.

10. Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nishizawa et al (Nishizawa et al: "10-Gb/s Optical DPSK Packet Receiver Proof Against

Art Unit: 2613

Large Power Fluctuations”, IEEE Photonics Technology Letter, Vol. 11, No. 6, June 1999, pages 733-735) in view of Hoshida et al (US 2005/0047780) and Leibrich et al (Leibrich et al: “CF-RZ-DPSK for Suppression of XPM on Dispersion-Managed Long-Haul Optical WDM Transmission on Standard Single-Mode Fiber”, IEEE Photonics Technology Letter, Vol. 14, No. 2, February 2002, pages 155-157)

Nishizawa et al discloses an optical transmitter (Figure 1), in an optical transmission system comprising:

the optical transmitter (the Transmitter in Figure 1) which outputs differential-encoded, phase-modulated light (Figure 1, the DPSK signal); and an optical receiver (Figure 1, the Optical Packet Receiver) which detects the phase-modulated light and performs demodulation (the demodulated signal is output from the balanced receiver), wherein the optical transmitter comprises: an encoder (the NRZ-I Encoder in Figure 1) which converts NRZ code input signals into NRZ-I code signals; and a phase modulator (the Phase Modulator in Figure 1) which, for marks and spaces encoded by the encoder (shown in “Phase modulated signal” in Figure 1), outputs phase-modulated light with a phase deviation $\Delta\phi$ imparted over a range $0 \leq \Delta\phi \leq \pi$ (the DPSK signal has 0 or π phase as shown above the “Phase modulated signal” in Figure 1),

the optical receiver comprises: a Mach-Zehnder interferometer (the 1-bit Delay Mach-Zehnder interferometer in Figure 1) to set a phase difference between two interfering signals, which splits the phase-modulated light which has been received into two signal light beams (Figure 1, the MZ interferometer splits the received DPSK signal into two signal light beams), delays one of the split signal light beams by one bit (Figure

Art Unit: 2613

1, page 733), and causes the two signal light beams to interfere to effect conversion into intensity-modulated light (Figure 1, the output from the MZ interferometer is the intensity-modulated light); and a balanced photodetector (the Balanced Receiver in Figure 1) which performs photoelectric conversion of signal light from two output ports of the Mach-Zehnder interferometer, and outputs a difference in converted electrical signals (the Electrical signal shown in Figure 1),

But, Nishizawa et al does not expressly disclose that the Mach-Zehnder interferometer has phase-adjustment terminal, and the optical transmitter comprises: a clock signal generation circuit which generates a clock signal having the same bit rate as a signal bit rate; and an intensity modulator which uses the clock signal output from the clock signal generation circuit to perform intensity modulation of the phase-modulated light.

However, Hoshida et al teaches a DPSK system in which Mach-Zehnder interferometer has phase-adjustment terminal (Figures 3-6, [0030]-0034]), and the optical transmitter comprises: a clock signal generation circuit (Figure 2, CLK 56) which generates a clock signal; and an intensity modulator (Intensity Modulator 56 in Figure 2) which uses the clock signal output from the clock signal generation circuit to perform intensity modulation of the phase-modulated light ([0026]).

Hoshida discloses "Clock 56 provides a synchronization signal that intensity modulator 58 utilizes to modulate the received DPSK signal using bit synchronous intensity modulation. But, Hoshida does not expressly state that the clock signal has the same bit rate as a signal bit rate.

However, Leibrich et al discloses a RZ-DPSK system (Figure 1), in which the optical transmitter comprises: the clock signal has the same bit rate as a signal bit rate (Figure 1, the 10 GHz clock signal); and an intensity modulator which uses the clock signal output from the clock signal generation circuit to perform intensity modulation of the phase-modulated light (Figure 1, page 155, first MZM is the phase modulator to generate the NRZ-DPSK, and the second MZM is the intensity modulator to generate the RZ-DPSK).

By using the phase-adjustment terminal and the feedback control, Hoshida et al provides “an optical receiver that monitors quality of a channel and adjusts differential decoding of the channel to enhance channel quality”, and by using the clock signal and the intensity modulator, a RZ-DPSK signal can be obtained to improve the tolerance to non-linear effects (XPM etc).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the phase-adjustment terminal, and the clock signal and intensity modulator as taught by Hoshida et al and Leibrich et al to the system of Nishizawa et al so that a RZ-DPSK system with enhanced quality and better tolerance to non-linearity can be obtained.

Allowable Subject Matter

11. Claim 22 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Heflinger et al (US 6,396,605);

Milivojevic et al: "Practical 40Gbit/s CSRZ-DPSK Transmission System With Signed Online Chromatic Dispersion Detection", Proc. ECOC'03 Rimini, Italy 2 (2003) Tu3.6.4, pages 268-269 ;

Swanson et al: "High Sensitivity Optically Preamplified Direct Detection DPSK Receiver With Active Delay-Line Stabilization", IEEE Photonics Technology Letter, Vol. 6, No. 2, February 1994, pages 263-265.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to LI LIU whose telephone number is (571)270-1084. The examiner can normally be reached on Monday-Friday, 8:30 am - 6:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ken Vanderpuye can be reached on (571)272-3078. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2613

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Li Liu/
Examiner, Art Unit 2613
June 18, 2009